IN THE CLAIMS

Please cancel claims 1 through 15, and add claims 16 through 46, as set forth below.

1 – 15. (canceled)

16. (new) A substrate material for an optical component for X-rays of wavelength λ_R, comprising:

a glass phase made of amorphous material having a positive coefficient of thermal expansion; and

a crystal phase including microcrystallites having a negative coefficient of thermal expansion and a mean size of less than about 4 λ_R,

wherein said substrate material has a stoichiometric ratio of said crystal phase to said glass phase such that a coefficient of thermal expansion of said substrate material is less than about 5 x 10^{-6} K^{-1} in a temperature range of about 20°C to 100°C, and

wherein said substrate material, following a surface treatment, has a high spatial frequency roughness (HSFR) of less than about $\lambda_R/30$ rms.

17. (new) The substrate material of claim 16, wherein said coefficient of thermal expansion of said substrate material is less than about 1 x 10^{-6} K^{-1} in said temperature range.

18. (new) The substrate material of claim 16, wherein said mean size is less than about 2 λ_R.

19. (new) The substrate material of claim 16, wherein said mean size is less than about λ_R.

20. (new) The substrate material of claim 16, wherein said mean size is less than about $2\lambda_R/3$.

21. (new) The substrate material of claim 16, wherein said mean size is less than about $\lambda_R/2$.

22. (new) The substrate material of claim 16, wherein said HSFR is less than about $\lambda_R/50$ rms.

23. (new) The substrate material of claim 16, wherein said HSFR is less than about $\lambda_R/100$ rms.

24. (new) The substrate material of claim 16, wherein said wavelength λ_R is in a range of about 10 nm to 30 nm.

25. (new) The substrate material of claim 16, wherein said surface treatment includes superpolishing a surface of said substrate material, and thereafter, beam processing said surface.

26. (new) The substrate material of claim 16, wherein said substrate material has a low spatial frequency roughness in a range of about $\lambda_R/50$ to $\lambda_R/100$ rms.

27. (new) The substrate material of claim 16, wherein said substrate material has a middle spatial frequency roughness (MSFR) in a range of about $\lambda_R/50$ to $\lambda_R/100$ rms.

28. (new) The substrate material of claim 27, wherein said MSFR is achieved by beam processing a surface of said substrate material.

29. (new) The substrate material of claim 16, wherein said optical component is a reticle mask.

30. (new) The substrate material of claim 16, wherein said optical component is a normal-incidence mirror providing reflectivity of greater than about 70% to said X-rays at non-grazing incidence.

31. (new) The substrate material of claim 30, wherein said normal-incident mirror has an aspherical shape.

32. (new) The substrate material of claim 16, further comprising a layered pair of materials thereon selected from the group consisting of Mo/Si, Mo/Bi, and MoRu/Be.

33. (new) The substrate material of claim 32, comprising about 40 to 200 layers of said layered pairs of material.

34. (new) A substrate material for an optical component for X-rays of wavelength 10 nm $\leq \lambda_R \leq$ 30 nm comprising:

a glass phase made of amorphous material having a positive coefficient of thermal expansion; and

a crystal phase including microcrystallites having a negative coefficient of thermal expansion and a mean size of less than about 38 nm,

wherein said substrate material has a stoichiometric ratio of said crystal phase to said glass phase such that a coefficient of thermal expansion of said substrate material is less than about 5 x 10^{-6} K^{-1} in a temperature range of about 20°C to 100°C, and

wherein said substrate material, following a surface treatment, has a high spatial frequency roughness (HSFR) of less than about $\lambda_R/30$ rms.

35. (new) The substrate material of claim 34, wherein said mean size is less than about 20 nm.

36. (new) The substrate material of claim 34, wherein said mean size is less than about 10 nm.

37. (new) An optical component for X-rays of wavelength λ_R, comprising:

a substrate material that includes:

a glass phase made of amorphous material having a positive coefficient of thermal expansion; and

a crystal phase including microcrystallites having a negative coefficient of thermal expansion and a mean size of less than about 4 λ_R,

wherein said substrate material has a stoichiometric ratio of said crystal phase to said glass phase such that a coefficient of thermal expansion of said substrate material is less than about 5×10^{-6} K^{-1} in a temperature range of about 20°C to 100°C, and

wherein said substrate material, following a surface treatment, has a high spatial frequency roughness (HSFR) of less than about $\lambda_R/30$ rms.

38. (new) The optical component of claim 37, wherein said optical component is a mirror selected from the group consisting of a normal-incidence mirror and a grazing-incidence mirror.

39. (new) The optical component of claim 37, wherein said optical component is a reticle mask.

40. (new) A method for producing a substrate material for an optical component for X-rays of wavelength λ_R, comprising:

superpolishing a surface of said substrate material until achieving a high spatial frequency roughness (HSFR) of less than about $\lambda_R/30$ rms; and

beam processing said surface until achieving a low spatial frequency roughness in a range of about $\lambda_R/50$ to $\lambda_R/100$ rms and a middle spatial frequency roughness (MSFR) in a range of about $\lambda_R/50$ to $\lambda_R/100$ rms,

wherein said HSFR is maintained at less than about $\lambda_R/30$ rms after said beam processing.

41. (new) The method of claim 40, wherein said superpolishing is performed until said HSFR is less than about $\lambda_R/50$ rms.

42. (new) The method of claim 40, wherein said superpolishing is performed until said HSFR is less than about $\lambda_R/100$ rms.

43. (new) An EUV projection system, comprising:

an illumination system for illuminating a mask; and

a projection lens system for projecting an image of said mask,

wherein at least one of said illumination system or said projection lens system includes an optical component for X-rays of wavelength λ_R having a substrate material that includes (a) a glass phase made of amorphous material having a positive coefficient of thermal expansion, and (b) a crystal phase including microcrystallites having a negative coefficient of thermal expansion and a mean size of less than about 4 λ_R,

wherein said substrate material has a stoichiometric ratio of said crystal phase to said glass phase such that a coefficient of thermal expansion of said substrate material is less than about $5 \times 10^{-6}\ K^{-1}$ in a temperature range of about 20°C to 100°C, and

wherein said substrate material, following a surface treatment, has a high spatial frequency roughness (HSFR) of less than about $\lambda_R/30$ rms.

44. (new) A system comprising a substrate material that includes:

a glass phase made of amorphous material having a positive coefficient of thermal expansion; and

a crystal phase including microcrystallites having a negative coefficient of thermal expansion and a mean size of less than about 4 λ_R,

wherein said substrate material has a stoichiometric ratio of said crystal phase to said glass phase such that a coefficient of thermal expansion of said substrate material is less than about 5 x 10^{-6} K^{-1} in a temperature range of about 20°C to 100°C,

wherein said substrate material, following a surface treatment, has a high spatial frequency roughness (HSFR) of less than about $\lambda_R/30$ rms, and

wherein said system is selected from the group consisting of an X-ray microscopy system, an X-ray astronomy system, and X-ray spectroscopy system.

45. (new) A substrate material for an optical component for X-rays of wavelength 10 nm $\leq \lambda_R \leq$ 30 nm, comprising:

an amorphous material having a positive coefficient of thermal expansion; and

crystallites having a negative coefficient of thermal expansion and being a mean size of less than about 38 nm,

wherein the substrate material has a coefficient of thermal expansion of less than about 5 x 10^{-6} K^{-1} in a temperature range of about 20°C to 100°C, and

wherein the substrate material has a high spatial frequency roughness (HSFR) of less than about $\lambda_R/30$ rms.

46. (new) The substrate material of claim 45, wherein the substrate material has a middle spatial frequency roughness (MSFR) in a range of about $\lambda_R/50$ to $\lambda_R/100$ rms, and a low spatial frequency roughness in a range of about $\lambda_R/50$ to $\lambda_R/100$ rms.